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Author(s): J. H. Shinn, Lawrence Livermore National Laboratory
K. J. Allwine, Pacific Northwest National Laboratory
G. E. Streit, Los Alamos National Laboratory

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THE DOE URBAN FIELD PROGRAM FOR 2000-2004

J. H. Shinn, K. J. Allwine, and G. E. Streit*
Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory,
and Los Alamos National Laboratory

1. BACKGROUND

The Department of Energy has initiated a large-scale urban diffusion program (URBAN) to provide field data for evaluation of simulation models. The DOE Chemical Biological Non-Proliferation Program will provide a modeling and prediction capability for the release of chemical and biological agents in an urban environment, and has included in the Program the resources to carry out necessary field tests for model validation. An Experimental Design Working Group has been established. In this presentation we will provide the concept and plans for these tests as they have developed to the time of the Conference.

Plans have been made to carry out URBAN preliminary tests in collaboration with another DOE field test, the Vertical Transport and Mixing Experiment (VTMX) in the Salt Lake Basin during October 2000. URBAN will complement VTMX by adding detail to the flow field and tracer studies in the Salt Lake City downtown. The VTMX/URBAN combine is planning to use tracers to define both the large-scale and the small-scale dispersion effects, where the latter examines the mean flow field and turbulence effects near the source and in the city center. The large-scale dispersion study examines the transport and dispersion influenced by the urban boundary layer and the mesoscale circulation patterns. In October 2000, URBAN collaborators will include NOAA, Air Resources Lab/Field Research Division (Idaho Falls), and meteorological research components from the Army Research Lab, Adelphi MD and from the Dugway Proving Ground, UT. In addition there are many VTMX collaborators and the VTMX project plans can be viewed on the web at http://www.pnl.gov/VTMX/4-00planmtg.html.

2. EXPERIMENT OVERVIEW

Meteorological and tracer instrumentation will be installed throughout the Salt Lake Basin for the month of October 2000. Instruments will be sited to resolve scales-of-motion ranging from flows around individual buildings in downtown Salt Lake City (SLC) to flows throughout the greater Salt Lake Basin. Six tracer experiments are planned during October where 3 perfluorocarbon tracers (PFTs) will be released from around the Salt Lake Basin, and sulfur hexafluoride (SF_6) and 2 additional PFTs will be released from downtown Salt Lake City. A total 6 inert tracer gases (5 PFTs and SF_6) will be released during nighttime hours (release durations ranging from 3 h to 8 h) under conditions of weak synoptic forcing – where the mesoscale processes (e.g., lake-land breeze, slope flows, mountain-valley winds) are controlling the local meteorology.

Tracer samples will be collected at 200 samplers located throughout the Salt Lake Basin. The sampling will extend from just before release start (~2200) through the night until the next afternoon (~1400). The tracer samplers will be distributed to resolve the various scales-of-motion being studied: 1) building-scale – 40 SF_6 samplers will be located around two buildings in downtown SLC; 2) downtown-scale – 40 SF6/PFT samplers will be located in a 4-block-square area (16 blocks) of downtown SLC, and 60 SF_6 samplers will be located around SLC extending 6 km from the SF_6 release location; 3) basin-scale – 60 PFT samplers will be located throughout the Salt Lake Basin tracking PFT releases out to roughly 40 km transport distances. In addition to the 200 tracer samplers deployed during the experiments, 6 fast-response SF_6 analyzers will also be deployed in downtown SLC to continuously measure SF_6 concentrations at 1 Hz, and one mobile PFT analyzer will travel around the basin measuring PFT concentrations every 5 minutes.

Numerous meteorological instruments will be deployed throughout downtown SLC and throughout the Salt Lake Basin to characterize the meteorology governing vertical exchange processes and atmospheric transport and diffusion. The major instrumentation deployed during October 2000 includes 40 surface weather stations; 7 radar profilers and 4 acoustic sodars continuously measuring wind profiles; 4 rawinsonde free-release balloon systems measuring profiles of wind and temperature every 1-2 hours throughout the experimental periods; 4 tethered-balloon systems measuring wind and temperature profiles periodically during each experiment; 60 temperature data loggers mapping temperature near the surface throughout downtown SLC and across the Salt Lake Basin; 20 sonic anemometers for measuring turbulence and flux profiles at two locations in the basin and for measuring turbulence characteristics around select buildings in downtown SLC; and a doppler lidar for continuously mapping winds across the Salt Lake Basin during the experimental periods.

3. WIND CLIMATOLOGY

The wind climatology analysis shows a very definite diurnal wind pattern both for the "Fall" and "Winter"

* Joseph H. Shinn, Lawrence Livermore National Laboratory
P.O. Box 808, L-396, Livermore, CA 94551
(e-mail: shinn1@llnl.gov, tel. 925-422-6806, fax: 925-422-5673

periods. The winds through downtown are typically from the SE at night and from the NW during the day especially under conditions of weak synoptic forcing. The wind analysis using 3 month of data from the 7 CBNP stations across SLC reveal that mesoscale effects (mountain-valley winds, slope winds, land-lake breeze) dominate the near-surface wind patterns across SLC. The wind analysis for 3 years of Fall and Winter Utah Mesonet data show Fall and Winter wind climatology around downtown SLC to be very similiar (SE at night, NW during day). This is based on 4 stations in the area. Since the Fall and Winter wind climatology are very similar (dominated by mesoscale forcing), the "case study" days were identified from the data collected at the 7 CBNP stations from 1/21/2000 through 4/12/2000.

4. EXPECTED RESULTS

The October 2000 study will provide a considerable amount of data for model evaluations in the future. For modeling the near-field air flow and dispersion, the CBNP approach is to use the Computational Fluid Dynamics methods. Several papers using CFD models will be presented here this week, many of them from the CBNP Program. The mesoscale models under development for CBNP use are reviewed here also.

In 2001-2003, URBAN will take on a more complete field study and involve more collaborators. Progress on model evaluations and lessons learned during the preliminary study will influence the experimental design of this major field test. The experimental effort will be finished in 2003, and the interpretation of data, model evaluations and publications will be completed in 2004.

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